Teaching BIM as an integrated Multidisciplinary program (Case study Syrian virtual university)

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Abstract

Although Building Information Modeling (BIM) is widely adopted all over the world, it is still considered a new approach in Syria, and only a few educational institutions apply it. Therefore, it is important to publish academic studies on BIM models and to train new professionals who can implement BIM in the architecture, construction, and operation sector (AECO). This study aims to measure the maturity of BIM at the Syrian Virtual University (SVU) in order to evaluate and develop the Building Information Modeling and Management (BIMM) master's program. The research methodology is based on measuring maturity using a maturity measurement tool for higher education institutions (BIM maturity matrix for higher education institutions or BIM-HEI), in addition to distributing an electronic questionnaire to BIMM master's students, with a sample size of 93 students. Based on the results of the maturity measurement and respondents' answers, this study proposes recommendations and proposals to develop the master's program. Furthermore, it presents a new contribution by presenting a successful model for teaching BIM in universities, which can serve as an example for educational institutions in Syria to plan and adopt BIM in their curricula, while properly disseminating and adopting the BIM culture within their universities.

Keywords: BIM maturity; Higher education institutions; BIM adoption; BIM teaching; BIM Courses; curricula

1. Introduction

Education is the heart of BIM development; The preferred learning outcome for BIM education at the undergraduate level, as determined by professionals in the field, is the mastery of BIM software skills. However, it is crucial for graduates in the Architecture, Engineering, and Construction (AEC) fields to not only focus on software proficiency, but also gain a strong understanding of BIM concepts and practical knowledge. This is because BIM technologies are continuously advancing and mastering a single course or program is insufficient for long-term implementation.
BIM has been in development for over a decade and its benefits are now widely recognized (1), also it is believed that BIM is an effective and efficient tool (2),but blind adoption of BIM will cause many problems (3),BIM involves more than just upgrading hardware or software, it requires a structured approach to managing life cycle information related to a building (4).

In addition to have a great potential to solve problems between disciplines (5),it has become a crucial technology in modern times, with its influence extending to almost all disciplines (6).Furthermore, BIM

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can be applied to a wide range of subjects and areas (7) ,The widespread applicability of building information models has turned them into a shared knowledge resource (8).

The advantages of BIM have been acknowledged by developed countries (9), Despite this recognition, the actual adoption of BIM has remained lower than expected (10).
One should recognize potential hazards (11), where Asset owners are faced with BIM implementation challenges (12), The primary obstacles to BIM adoption include a lack of expertise, inadequate standardization, and insufficient protocols (13), In addition to the technical challenges, resistance to change and lack of awareness about BIM (14), in general The barriers that an organization may face at different levels of BIM maturity are not yet fully understood (15), Many studies have shown that the universities trying to implement BIM in their curricula (16), A major issue with integrating BIM into education is the fact that there is no proper integration of BIM as a discipline or field into curricula, which may discourage faculties from devoting time and energy to educating themselves or from incorporating BIM into teaching or research, When these challenges are overcome, BIM, as a new information technology, promises to enable a new level of collaborative engineering and knowledge management (17).

However, Syrian Virtual University was the first in incorporating BIM into teaching, by created a master's program specializing in building information modeling and management (BIMM), which is considered the first of its kind in the Middle East.

This study came to explain what this program is and its objectives, then evaluate and develop it, in order to circulate this experience later on the rest of the Syrian universities to adopt BIM and raise the level of education and engineering work.

2. BIM maturity:

Similar to how an odometer is used to measure vehicle mileage and the Leadership in Energy and Environmental Design (LEED) rating system is used to assess building performance (18) where specific features or areas of BIM define the ideal state or standard that should be achieved.

According to (19), BIM maturity refers to the ongoing and progressive exhibition of capability to provide BIM at an organizational, team, market, or national level , It is evident that there has been a rise in the number of metrics used to evaluate the level of BIM maturity in individuals, organizations, and projects (20), Maturity models are often considered as tools for achieving a competitive advantage through improvement (21).

A mature company in this context is one that demonstrates good stability, control, and performance in their use of BIM (22), "Mature information" refers to data that has reached the highest level of stability, accuracy, and completeness (23), The maturity of BIM implementation also refers to how extensively BIM is being used (24).

BIM implementation progresses through sequential stages of the progression process, from the early stage to the excellence stage, with the current state of BIM application being the point of reference. Defining the current state helps identify areas for prioritization and subsequent improvement, and assessing the current state of maturity enables comparisons across companies, disciplines, projects, and countries to distinguish between mature and immature entities (25).

The assessment acts as a rating system that identifies the important areas and characteristics for each maturity level to deliver BIM products or services effectively.
BIM maturity also describes the context in which BIM is implemented or context of BIM use (26), a company's BIM maturity refers to the extent of knowledge a company has going
forward with BIM implementation based on its ability throughout the project or building
lifecycle, Companies can improve their BIM performance by using the BIM maturity matrix (BIM3), which involves three stages (27)

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1) Identifying BIM and its performance
2) Performance measurement
3) Performance improvement.
The term BIM maturity refers to the incremental and continuous improvement in quality, repeatability and predictability within available BIM capability, measured by the BIM Maturity index which consists of five distinct maturity levels (see Figure 1).
(A) primary/dedicated, (B) defined, (C) managed, (D) integrated and (E) optimized.
In general, progression from lower to higher levels of BIM maturity indicates:
(i) minimizing discrepancies between objectives and actual results, which leads to better control.
(ii) reducing variability in efficiency, performance, and costs, which enhances predictability and forecasting.
(iii) increasing effectiveness in achieving established goals, and even setting new, more challenging ones (28).

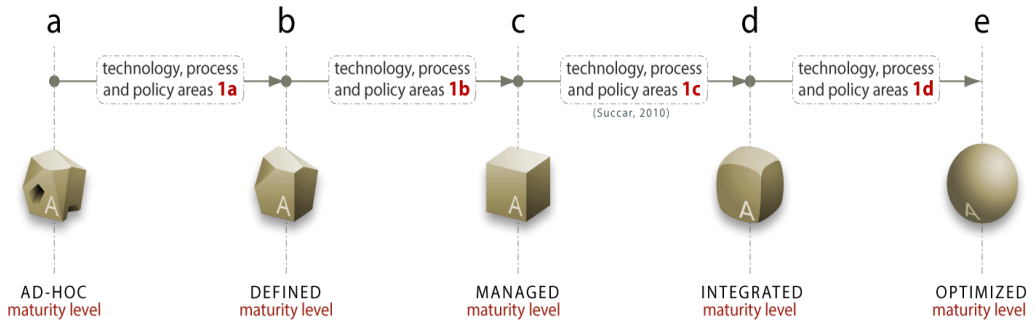

Figure 1: BIM Maturity Levels, Resource: Reference 28 (2009).

3. Teaching BIM in Syria:

Today, the architectural, engineering, construction, and operation (AECO) industry is motivated to employ graduates educated about Building Information Modeling (BIM) tools, techniques, and processes, which help them to better integrate visualizations and data into their projects.
It appears that in Syria, there is a gap and lack of skills (29), where (BIM) is not yet widely adopted and is considered a new approach where only a few educational institutions use it without proper planning (30).Therefore, awareness should be spread about BIM and its tools for its use in Syria (31), One of the factors contributing to the growth of BIM is its adoption by higher education institutions (HEIs) (32).

in Syria, Higher education Institutions (HEIs) need to allocate more time and effort to qualify engineers and help them to keep up with the latest technologies. In addition, many workers in the construction industry lack the necessary knowledge and skills to utilize the BIM system effectively (33).This is particularly affecting the AEC sector, where many engineers have not had the opportunity to work on projects that are based on new technologies and methodologies (34), Which helps in increasing the efficiency of new buildings (35).Therefore, it is crucial to provide students with the necessary skills and knowledge of BIM concepts to remain relevant and increase employability in the rapidly evolving construction industry, to achieve this, BIM must be incorporated into the curriculum (36).

It appears that plans for adopting BIM in Syria have started to become clearer, and there is now a roadmap in place to facilitate the adoption of BIM (37), where authors in (38) are developing a new plan in Faculty of Architecture at Al-Baath University. This plan is expected to prepare a new generation of architects who are High-tech qualified and fully aware of BIM and its general ideas, which makes it easier for these architects to emerge within the job market and fulfill AEC firms' requirements, of course, this would also help to promote the university's reputation and help to spread BIM education among other local universities and also to other engineering competencies.

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This study came to explain what this program is and its objectives, evaluate and develop it, and circulate this experience later on the rest of the Syrian universities to adopt BIM and raise the level of education and engineering work.

3.1 Syrian Virtual University (SVU):

The Syrian Virtual University (SVU) was the first institution in the Middle East to offer a Master's program in Building Information Modeling and Management (BIMM) in 2020, following a decision by the Ministry of Higher Education. SVU is known for its commitment to continuous evaluation and improvement.

This study aims to evaluate and enhance the BIMM program. The program aims to provide quality education to Syrian students in various professional fields.

3.2 BIMM master's program Goals:

The purpose of this program is to qualify student's for project management and implementation monitoring using Building Information Modeling. He is also qualified in construction project management and aspires to become an expert using BIM to:
1. enhance learners' skills in project management and monitoring through the utilization of BIM technology.
2. improve learners' proficiency in utilizing information technology.
3. improve individual and collective work skills and enhance effective communication among co-workers.
4. provide consultation services to companies and institutions in order to facilitate their transition towards BIM technology in a gradual and effective manner. This can help these organizations improve their performance, reduce costs, and enhance their competitiveness in the market.
5. enhance the learners' abilities to negotiate, design, and complete BIM projects that meet their own and their employers' requirements. It also aims to develop their skills in participating in negotiations related to the adoption of BIM technology.
6. develop the learners' skills in conducting scientific research at the national, regional, and international levels.
7. Encourage the use of technical English (30).

This requires a specialized scientific foundation and knowledge in the following areas:

- Building information modeling and data interoperability.
- Fundamentals of project management and follow-up.
- Performance analysis and evaluation and strategy development (institutional development).
- Management of construction contracts and BIM-based contracts.
- Modeling and decision-making methods.
- Human resource management.
- BIM dimensions and levels.
- Sustainability and maintenance using BIM.

3.3 The indicative study plan for BIMM program:

The duration of study for the master's degree in Building Information Modeling and Management is a minimum of two years, and a maximum of four years, the program consists of 4 terms, in each term there are 5 courses totaling 15, except for the last term, which includes a master project, as shown in fig (2).

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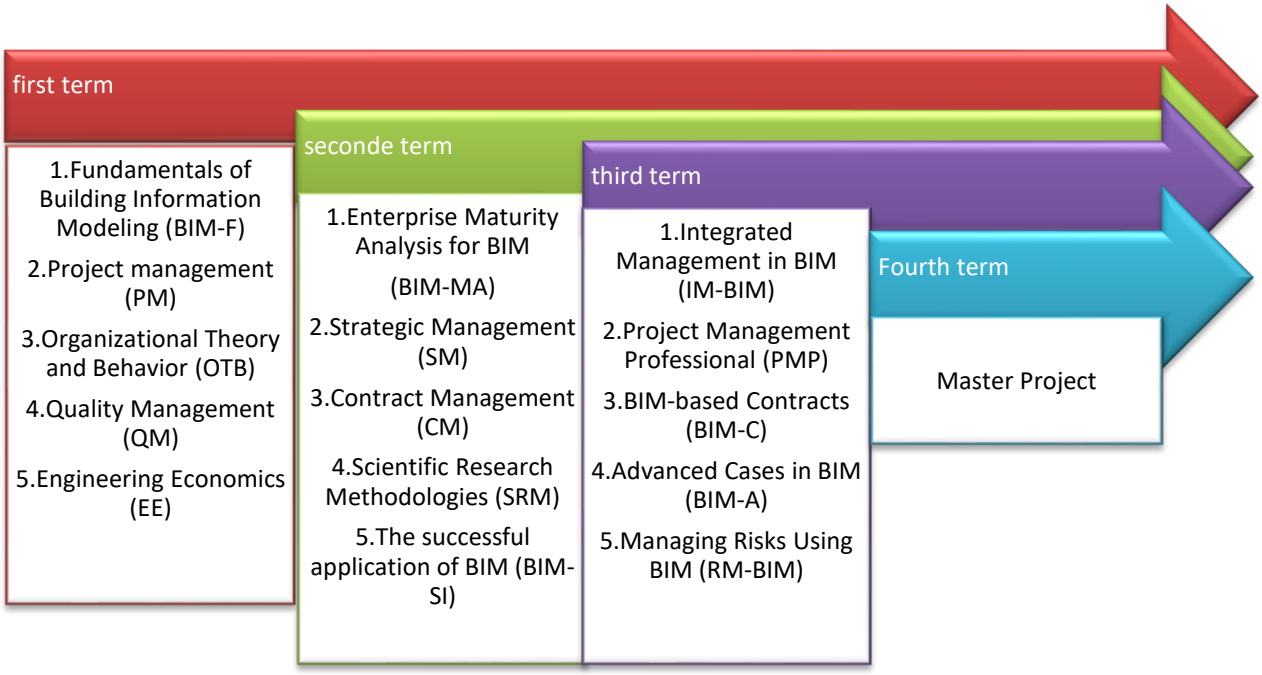

Figure 2: The indicative study plan for the program BIMM, Resource: Creations by authors (2023).

4. methodology:

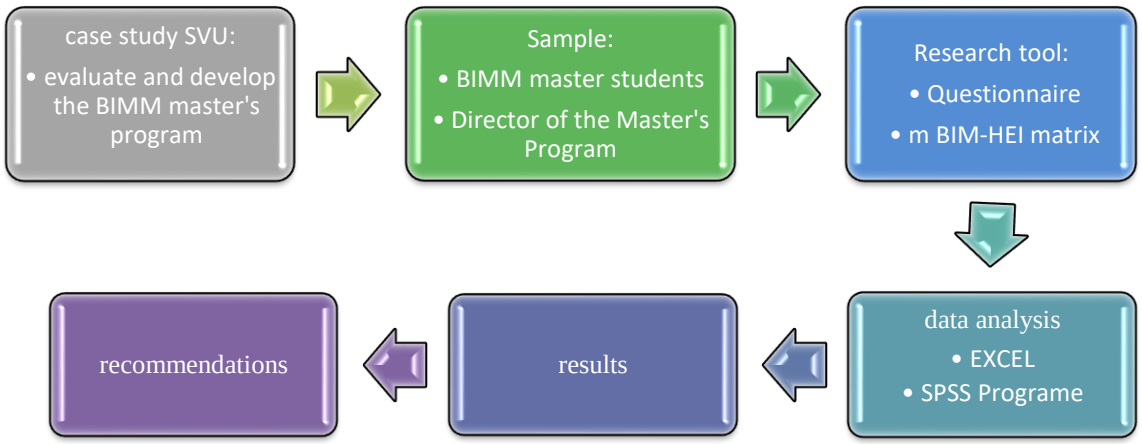

Figure 3: Methodology of the research, Resource: Creations by authors (2023).

5. Sample

The results of this study are based on the measurement of BIM maturity using the m BIM HEI matrix, which was sent to the director of the BIMM master's program. In addition, survey answers were collected from the BIMM master's students via email and social media.The survey responses were subjected to an audit process.

The total sample size for the study was 93 students.

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6. Research tool:

6.1 BIM Maturity Matrix for HEIs (m BIM-HEI):

The BIM Maturity Matrix for HEIs (m BIM-HEI) is a tool designed specifically for use by universities and colleges. Its purpose is to assess the BIM maturity level of either the institution as a whole or a specific program within the institution. It can be utilized by internal stakeholders to measure performance, or by external parties for evaluation purposes.
The m BIM-HEI is divided into three BIM fields: Policy, Processes and Technology (18).
Presented and conceptualized in Table (1). In each BIM field there is a set of criteria totaling 15 criteria.
The theoretical model of m BIM-HEI, illustrated in (39).
https://www.scielo.br/j/ac/a/cfKwhCtwVYZPtNmxPMkRpvb/abstract/?lang=en
presents the maturity on a progressive scale of five levels: (see Figure 4).
(a) pre-BIM;
(b) initial;
(c) defined;
(d) integrated; and
(e) optimized (18).
The advance in maturity levels is related to the gradual, continuous improvements and to the formalization and institutionalization of BIM within the HEI. The Pre-BIM level is the absence of BIM in the HEI, while the Optimized level consists of the highest maturity level.
Maturity is measured by the Maturity Degree (MD), through the Maturity Index (MI).
The Maturity Degree Consists of an arithmetic average of the 15 evaluated items (the sum of the scores divided by 15), with a maximum score of 50 points. The Maturity Index is a percentage value, in which the Maturity Degree is referenced to the maximum score (100%). The BIM Maturity Level is obtained through join ship between Maturity Index and Maturity Degree (40), illustrated in Table 2.

Table 1: BIM^3 x m^2 BIM-HEI Maturity Fields, Resource: Reference 39 (2021).

Field	BIM^3 (SUCCAR, 2010)	m^2BIM-HEI
policy	The Policy Field refers to a group of stakeholders who are primarily focused on training professionals, conducting research, distributing benefits, allocating risks, and reducing conflicts within the AECO	The Policy Field encompasses various initiatives, actions, and institutional perspectives related to BIM, including the training of faculty staff, their engagement with BIM, the institutional vision for BIM, and actions related to BIM teaching and academic extension.

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process	The Process Field refers to a group of actors involved in various stages of the AECO industry, including acquisition, design, construction, manufacturing, usage, management, and maintenance of structures.	The Process Field refers to the actors involved in the acquisition, design, construction, manufacturing, use, management, and maintenance of structures who utilize BIM. This field encompasses the various applications of BIM in different disciplines, the level of involvement of BIM in each discipline, the quality and quantity of scientific publications on BIM, and the extent of BIM education and training for students.
technology	The Technology Field encompasses actors who specialize in developing software, hardware, equipment, and network systems that are essential for improving the efficiency, productivity, and profitability of AECO sectors.	The Technology Field encompasses the infrastructure and resources necessary for the development of teaching, research, and BIM extension in Higher Education Institutions. This includes both technological and physical means, such as institutional agreements with software developers and hardware manufacturers, types and uses of software and hardware, and the physical infrastructure of BIM learning spaces.

Table 2 : BIM Maturity Degree, Maturity Index and Maturity Level Relation
Resource: Reference 40 (2018).

BIM MATURITY DEGREE			
	Maturity Index	**Maturity Level**	**Text Classification**
A	0-19%	Pre-BIM	No maturity
B	20-39%	Initial	Low maturity
C	40-59%	Defined	Medium maturity
D	60-79%	Integrated	High maturity
E	80-100%	Optimized	Very high maturity

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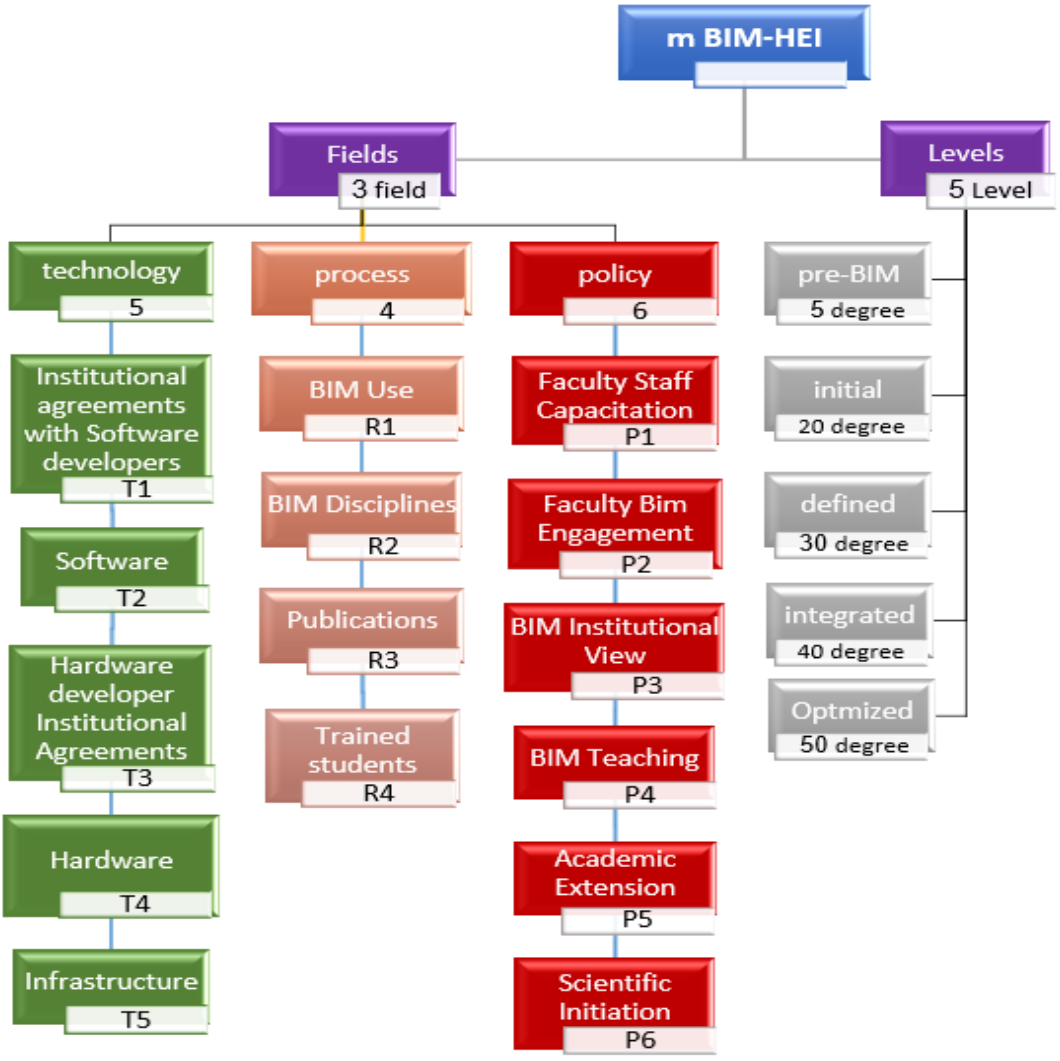

Figure 4: component of (m BIM-HEI), Resource: Creations by authors (2023).

6.2 Questionnaire:

The researcher conducted a survey as a supportive step to gather factual information about the status of the BIMM master's program. The survey aimed to obtain feedback from students.
The primary objective of sending the questionnaire was to evaluate and improve the master's program by providing an opportunity for students to express their opinions and suggestions honestly and transparently.
The questionnaire is divided into two sections:
The first section covers specialization, the scientific level of the program, the teaching staff, technical training, software used, scientific publishing, and other related topics.
The second section contains 30 phrases distributed over three axes, as follows:
The first axis focuses on the weaknesses of the BIMM master's program and contains seven phrases.
The second axis of the questionnaire focuses on proposals for the development of the BIMM master's program and includes 8 phrases, the third axis is aimed at evaluating the practical benefit of the courses offered in the program and includes 15 courses.

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7. results:

7.1 results of maturity (m BIM-HEI):

The BIM maturity level is obtained through the relationship between the maturity index and the degree of maturity, shown in Table (3).
The maturity score is the arithmetic average of the 15 items assessed (sum of the score divided by 15), with a maximum score of 50.
The maturity index (MI) is a percentage value, in which the degree of maturity is indicated to the maximum degree (100%). (40)
After answering the matrix by the director of the master's program and analyzing the results shown in Table (3), it is founded that the current level (BIM application point) of the Virtual Syrian University is the integrated level, this show a high level and clear progress in BIM implementation.

Table 3: The results of measuring maturity in the SVU
Resource: Creations by authors (2023).

code	creation	degree	Maturity degree	Maturity index	Maturity level
P1	Faculty Staff Capacitation	30	41.6	83.2%	(Optimized) Very high maturity
P2	Faculty BIM Engagement	50			
P3	BIM Institutional View	50			
P4	BIM Teaching	45			
P5	Academic Extension	45			
P6	Scientific Initiation	30			
R1	BIM Use	30	35	70%	(Integrated) High maturity
R2	BIM Disciplines	40			
R3	Publications	45			
R4	Trained students	25			
T1	Institutional agreements with Software developers	20	28	56%	(Defined) Medium maturity
T2	Software	30			
T3	Hardware developer Institutional Agreements	40			
T4	Hardware	30			
T5	Infrastructure	20			
SVU			**35.33**	**70.66%**	**Integrated (High Maturity)**

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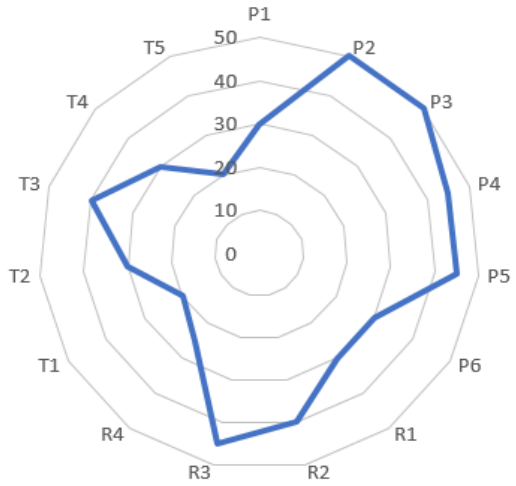

Figure 5: Average maturity scores for the (m BIM HEI) matrix criteria of SVU,
Resource: Creations by authors (2023).

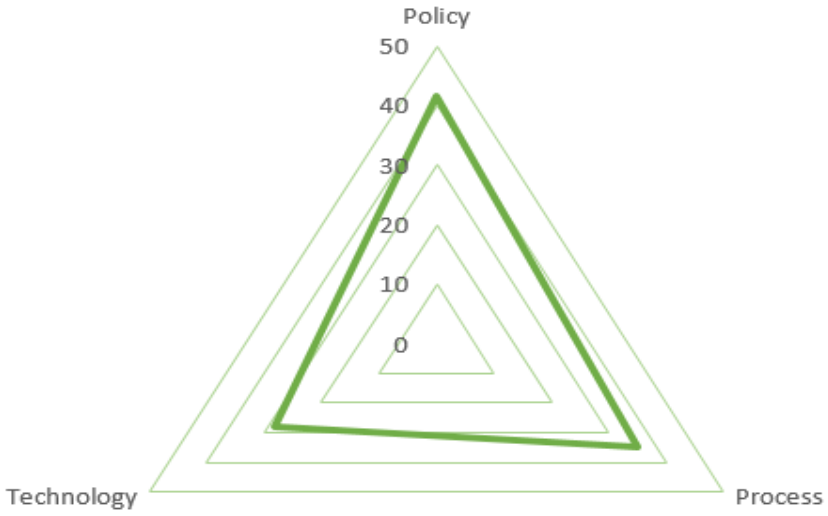

Figure 6: The average maturity level of BIM fields in SVU,
Resource: Creations by authors (2023).

It can be observed from Figure 5, which displays the average scores for each criterion, that nearly half of the criteria have scored 40 points or higher, indicating a high level of performance for the use of BIM. The criterion with the highest recorded score was 'participation in the field of BIM/point of view organization', with a score of 50. On the other hand, the criterion with the lowest score was 'institutional agreements with software/infrastructure developers', which scored 20.

After analysis of BIM fields defined by m BIM-HEI, it is noticed degree of maturity among three domains, Policy (41.6 points), Process (35 points), and Technology (28 points) is different.

Figure (6) illustrates that the technology field has a lower maturity level compared to other fields, suggesting that the issues related to low BIM maturity are concentrated in technical problems such as hardware and software. This finding indicates a need for increased efforts by the Virtual University to address these technical challenges and raise the overall maturity level.

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7.2 Questionnaire:

The response rate was 93 respondents, and the statistical data were analyzed by SPSS program.

a.Specialization:

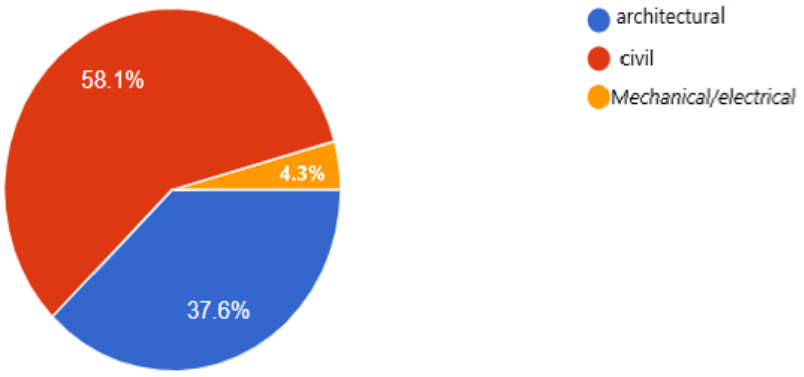

Figure 7: specialization of respondents, Resource: Creations by authors (2023).

It is noteworthy that the program includes a diverse mix of engineering disciplines, which is considered one of its strengths. By having engineers from various specializations work together on integrated projects, the program fosters interdisciplinary collaboration. However, it is observed that the percentage of electrical and mechanical engineers is relatively low at only 4.3%. To encourage more mechanical and electrical engineers to learn about BIM and its importance in their respective fields, it is recommended to conduct workshops, introductory sessions, and awareness lectures tailored specifically for these engineers.

b.Scientific level of the BIMM master's program:

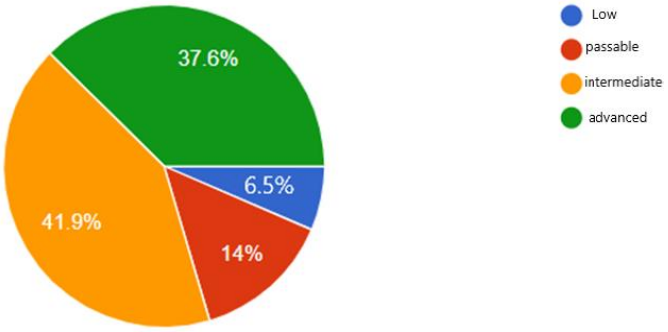

Figure 8: Scientific level of the BIMM master's program, Resource: Creations by authors (2023).

While the results indicate that the program is currently at a good level, it is important to note that further development is needed to address any gaps or weaknesses that may hinder its progress. Conducting regular evaluations and identifying areas that require improvement will be crucial in ensuring that the program continues to advance and reach an advanced level.

c.Adequacy of the program to enter the labor market:

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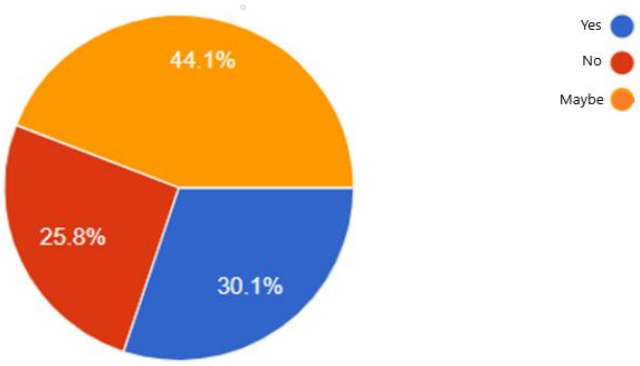

Figure 9: respondents answer for (Is the program sufficient to enter the labor market)?
Resource: Creations by authors (2023).

44.1% of the respondents stated that the program may qualify graduates for entry into the labor market. However, only 30.1% agreed that the program is sufficient for students to enter the labor market, while 25.8% felt that it is not sufficient. This indicates a weakness in the practical aspect of the program, or a lack of integration between theoretical concepts and their practical application. Graduates may find it challenging to apply the scientific concepts they learned during their university studies in the labor market. To address this issue, it is necessary to focus on the practical side of the program by incorporating BIM programs into the courses, similar to courses such as BIM-A/BIM-RM, which include BIM training and are highly valued (as shown in Table 4). Additionally, students should receive training in implementing integrated projects across various disciplines by working on real projects under the guidance of specialized supervisors and in collaboration with engineering companies.

d.Teaching staff qualification level:

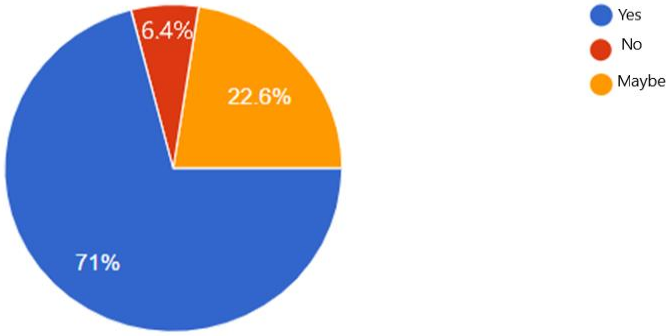

Figure 10: respondents answer for (Is the teaching staff sufficiently qualified)?
Resource: Creations by authors (2023).

The survey results revealed that 71% of the respondents believed that the teaching staff is sufficiently qualified. This large percentage suggests that the teaching staff is highly skilled and capable of leading the digital transformation in this specialized program through effective teaching and training.

e.students joining to training courses:

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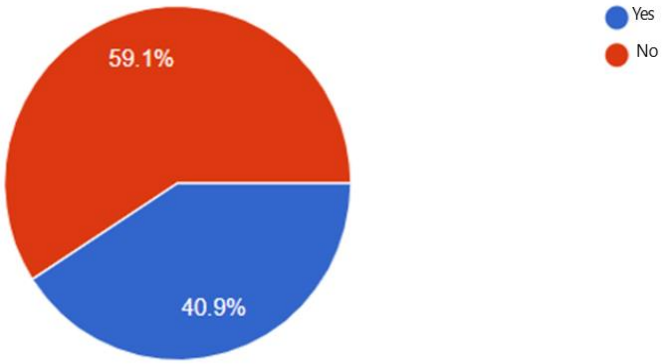

Figure 11: Percentage of students joining to training courses, Resource: Creations by authors (2023)

f.The adequacy of training courses to work on BIM program:

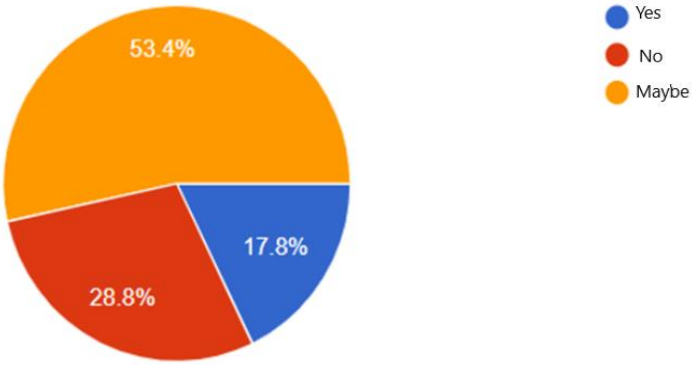

Figure 12: Students answer for (Did you obtain sufficient skills through the training courses)? Resource: Creations by authors (2023).

As shown in Figure (11), the survey showed that 59.1% of the respondents joined the training courses offered by the university, while 40.9% did not, so it is necessary to work on motivate students to join these courses by:

- Make the courses compulsory, i.e. make the requirement of mastering the BIM software as a condition for Graduation.
- Reducing the cost of these courses to suit all students.
- Opening educational centers in all cities.

It's also noticed from Figure (12) that 53.4% of the trainees answered that the training courses are somewhat capable of making the trainee able to work on BIM program, and 28.8% said that they are not sufficient, while only 17.8% answered yes that they are sufficient. Therefore, it is necessary to work more to develop the level of these training courses through:

- Developing Lifelong Learning Center platform to present the content clearly and smoothly to the trainees.
- attracting lecturers who specialize in BIM software to assist with teaching.
- developing the scientific content of these training courses to ensure that students receive a comprehensive education in BIM.
- Work on a real project to apply practical concepts directly.

g.Programs that respondents are used:

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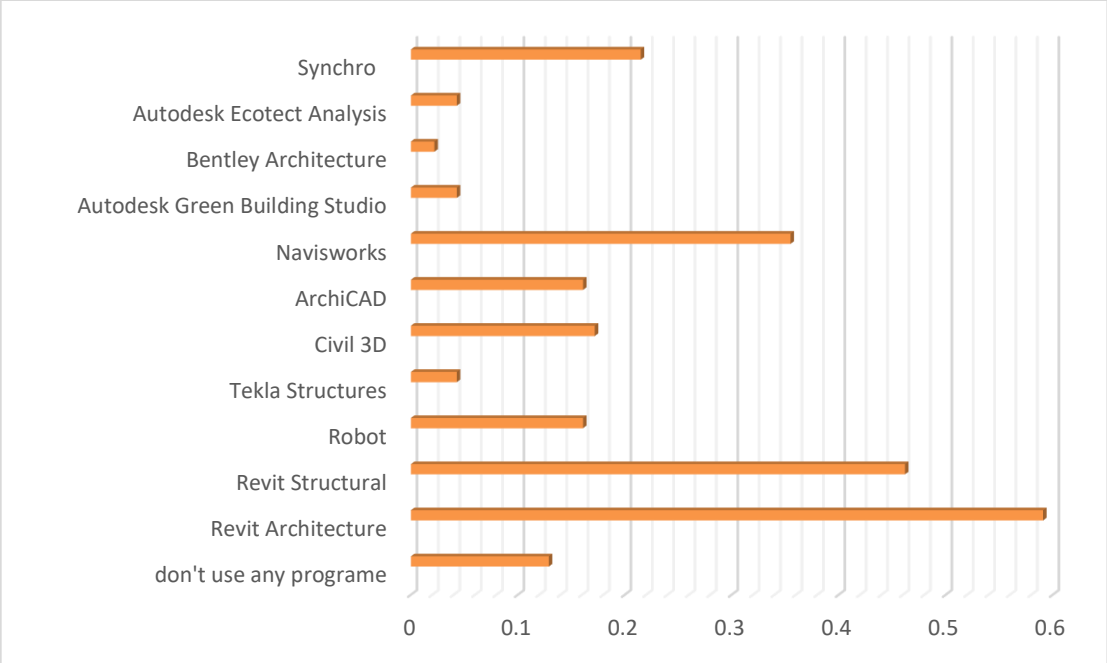

Figure 13: Programs that respondents are used, Resource: Creations by authors (2023).

The search results indicate that Autodesk products, particularly Revit, are the most widely used BIM software due to their advanced functionality, general features, compatibility with other programs, and high demand in the labor market. However, the survey revealed that the percentage of users utilizing environmental analysis programs was low, indicating the need to include these programs in the training courses to expand the knowledge base of students.

It is concerning that 12.9% of respondents reported not using any software, which is unacceptable for students specializing in building information modeling. Therefore, software proficiency should be a requirement for graduation, and software learning should be incorporated into the lectures prescribed in the study plan to ensure that students have the necessary skills to succeed in the field.

h.scientific publication:

Figure (14) reveals that the vast majority of respondents (90.3%) have not published any scientific research, which is inconsistent with the program's objectives of developing students' research skills at national, regional, and international levels and encouraging them to publish scientific papers. To address this issue, it is recommended that the program make scientific publication (one or two articles) a requirement for graduation. Additionally, honoring students who publish scientific papers could serve as a motivational factor.

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Received: June 21, 2022 Accepted: January 28, 2023

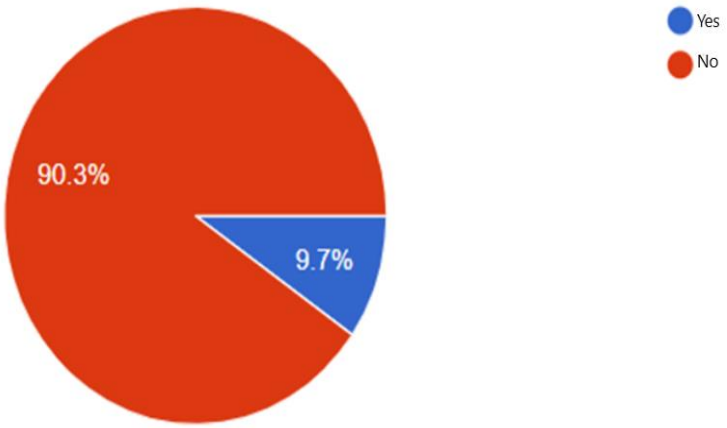

Figure 14: the percentage of scientific publication, Resource: Creations by authors (2023).

i.Weaknesses of BIMM program:

There were some weaknesses identified that affect the success of the BIMM Master Program, as shown in Fig (15). The weaknesses were arranged according to the degree of importance, with the following order:

The first and most significant factor was the lack of support from engineering institutions and companies, which students considered the biggest weakness in the BIMM program. The second most significant factor was technical problems, especially those that occurred during synchronous lectures and exams, which were classified as important.

Other significant factors were indicated by respondents as medium importance factors, including focusing on the theoretical side more than practical, the translation of BIM terms which causes the loss of ideas and incorrect understanding of the correct scientific meaning, the lack of Arabic references about BIM, the lack of organization, poor coordination and communication between students and teachers, and weakness in the courses.

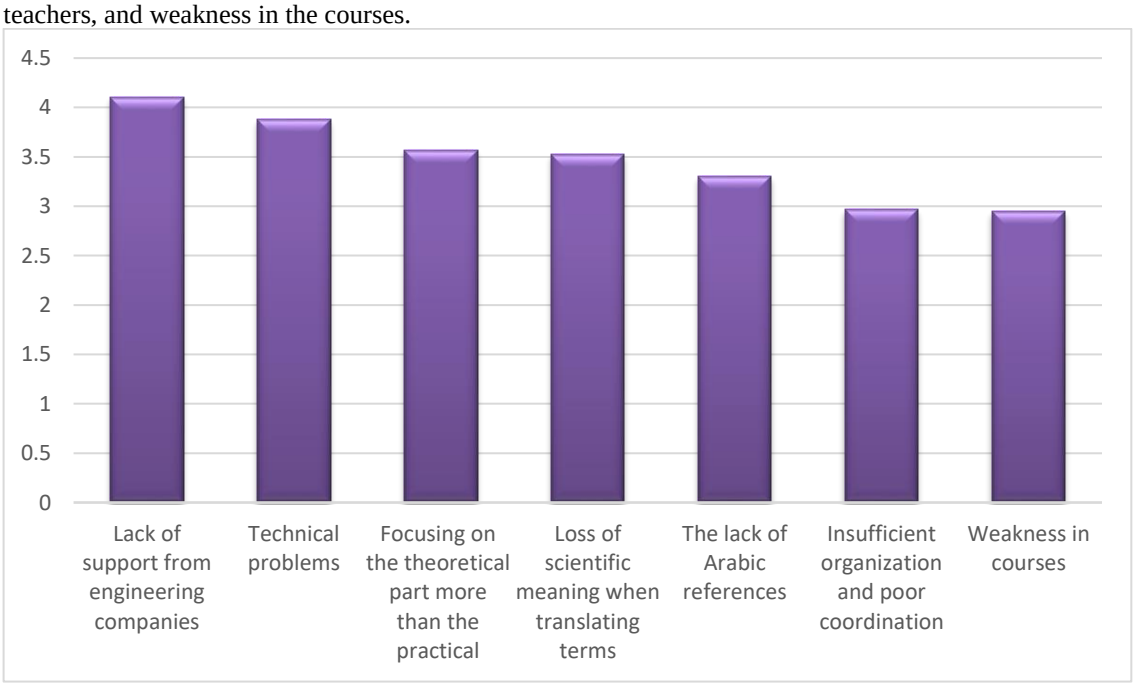

Figure 15: Arrangement of weaknesses according to their importance,
Resource: Creations by authors (2023).

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j.proposals for developing master program:
Suggestions have been made to develop the master program, which are arranged according to the degree of importance as indicated by the respondents:
Firstly, providing support from engineering institutions and companies to adopt graduate students was ranked the most important factor. The second most significant factor was developing an electronic public library that contains all references, theses, and scientific articles related to BIM, in addition to holding periodic workshops, both classified as (very important) level.
Other significant proposals were focusing on the practical side and reducing theoretical courses, recruiting qualified teaching and administrative staff specialized in BIM, the necessity of continuous evaluation of the content and available capabilities, and comparing them with international standards, and the need for more interactive content between the teacher and the student, organizing the course, and providing more comprehensive content, all classified as (important) level.
Figure (16) shows the distribution of proposals according to their importance.

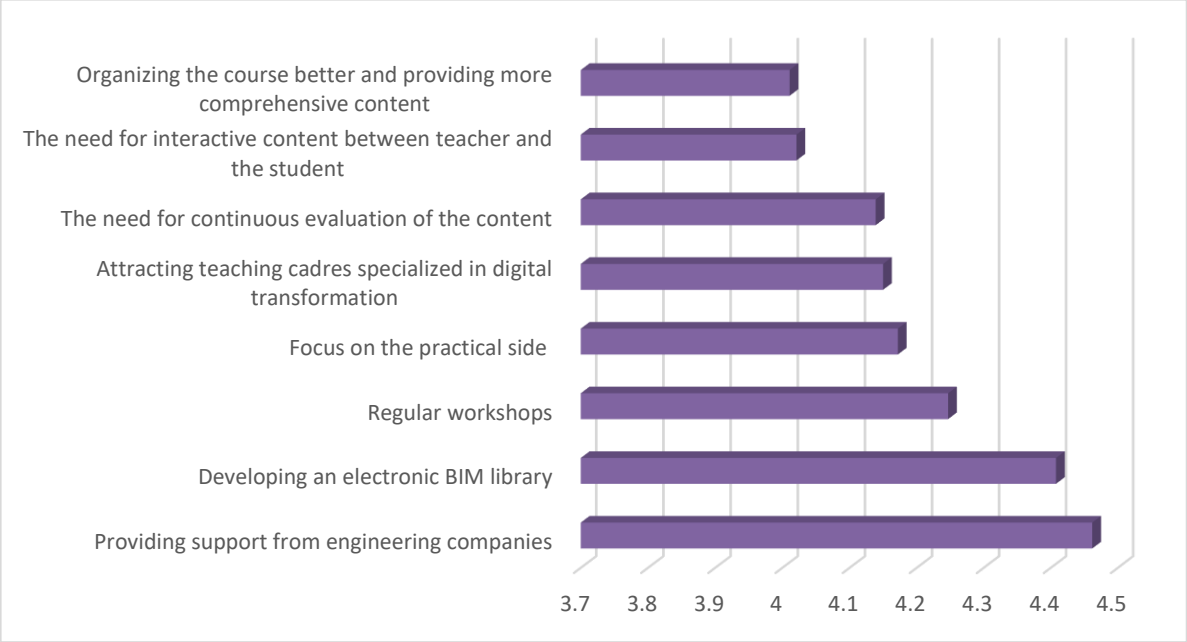

Figure 16: Distribution of proposals according to their importance,
Resource: Creations by authors (2023).

h. Arrangement of master courses according to the level of scientific interest:
The master courses were arranged according to their degree of importance, as shown in Figure (17). Integrated Management in BIM (IM-BIM) was ranked the most important course at a 'very important' level. On the other hand, Engineering Economics (EE) was ranked the least important course at a 'medium importance' level. Therefore, it is recommended to replace EE with another course specialized in BIM. See table (4)

Table 4: Courses classification in order of importance,
Resource: Creations by authors (2023).

very important	important	medium importance

Doi: https://doi.org/10.54216/IJBES.060104

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1. IM-BIM 2. PMP 3. BIM-A 4. BIM-MA 5. RM-BIM	6. BIM-F 7. PM 8. BIM-SI 9. BIM-C 10. QM 11. SM 12. SRM 13. CM 14. OTB	15. EE

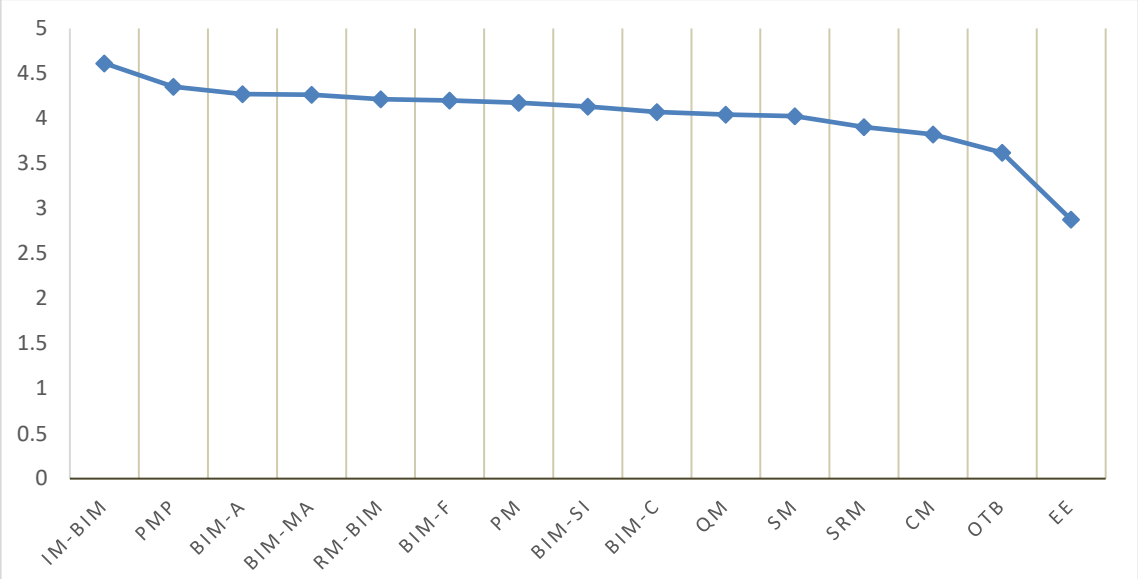

Figure 17: Arrangement of courses according to the level of scientific interest,
Resource: Creations by authors (2023).

6. Discussion and recommendations:

One challenging issue in BIM education is whether to integrate BIM teaching into existing curricula for engineering majors or to teach it as a standalone subject, as done in the BIMM Master program at SVU. It is believed that a combination of the two approaches may be the best solution, although change in the higher education sector can be slow.

There is a growing need for an integrated degree program that targets mature students with industry experience who want to acquire specialized knowledge and skills in BIM. “Also It is important for the government to establish BIM standards” (41), in addition to propose an integrated postgraduate program that goes beyond traditional disciplines and involves collaboration between colleges and even different universities, While this may be difficult to achieve, it is not impossible, given that BIM promotes collaboration in industry. For example, SVU could develop a specialized master's program in BIM and generalize it to other Syrian universities.

A detailed analysis was conducted for each criterion individually, and appropriate proposals were made to achieve the optimal degree, as shown in Table 5.

Doi: https://doi.org/10.54216/IJBES.060104

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Table 5: performance evaluation results / Recommendations, Resource: Creations by authors (2023).	
Key maturity areas (policies)	
Faculty Staff Capacitation (Score: 30 / Level: defined)	
Recommendations	• Develop a strategic plan to train teachers on BIM technology. • Make teacher knowledge of BIM a condition for employment.
Faculty BIM Engagement (Score: 50 / Level: optimized)	
Recommendations	No Recommendations
BIM Institutional View (Score: 50 / Level: optimized)	
Recommendations	No Recommendations
BIM Teaching (Score: 45 / Level: optimized)	
Recommendations	• Promoting a culture of teamwork among the students themselves, and between students and teachers, and making the Master's project a teamwork project, not an individual one. • Encouraging students to carry out integrated projects between disciplines by working on a real project in cooperation with engineering companies, with presence of a specialized supervisory staff.
Academic Extension (Score: 45 / Level: optimized)	
Recommendations	Developing a clear strategic plan and adopting this plan from official authorities, to be a road map for the development of BIMM master's program and dissemination of this experience within all Syrian universities.
Scientific Initiation (Score: 30 / Level: defined)	
Recommendations	Conducting joint research projects between SVU and other universities and institutions.
maturity areas (process)	
BIM Use (Score: 30 / Level: defined)	
Recommendations	Establishing additional trainer courses to learn all BIM uses.
BIM Disciplines (Score: 40 / Level: integrated)	
Recommendations	Organizing introductory and awareness workshops and lectures for all disciplines about importance of BIM within their specialization and engineering work, to motivate them to learn BIM, especially for mechanical and electrical engineers, due to small number of them coming to learn BIM.
Publications (Score: 45 / Level: optimized)	
Recommendations	• Develop a strategic plan for practical research and cooperation with other universities. • Providing the necessary infrastructure for practical research needs, including books, references, tools and software. • Providing the necessary financial resources to serve scientific research that requires special equipment and software.
Trained students (Score: 25 / Level: defined)	

Doi: https://doi.org/10.54216/IJBES.060104

Received: June 21, 2022 Accepted: January 28, 2023

Recommendations	•As university admission continues, it will reach the optimize level in 3 years at most. • Ensure that the numbers of accepted students in each semester are commensurate with the available capabilities to provide high-quality scientific content within the drawn plan. • Ensure that admission criteria are commensurate with the requirements of the program, because that reflected in the performance of students and the level of the program.
maturity areas (technology)	
Institutional agreements with Software developers (Score: 20 / Level: initial)	
Recommendations	• Developing a university software development plan within the university's strategic plan to develop it and solve technical problems facing students and faculty during lectures. • Developing the Lifelong Learning Center platform of SVU to provide integrated and clear course content in a convenient and easy way for students and teachers. • Contracting institutional agreements with software developers to provide the necessary software to work on BIM technology (outside and inside the university). • Setting strategic goals for the university, based on which necessary programs to selected and managed.
Software (Score: 30 / Level: defined)	
Recommendations	• Installing necessary software on all student devices and university devices in an institutional manner that is licensed and subject to supervision. • Work to enable interoperability of different programs by suggesting work formats such as IFC, which helps in the use, storage, exchange and management of data as part of general strategy of the university.
Hardware developer Institutional Agreements (Score: 40 / Level: integrated)	
Recommendations	Signing formal agreements with hardware developers to develop and modernize university's hardware.
Hardware (Score: 30 / Level: defined)	
Recommendations	Process of obtaining, managing and maintaining appropriate devices for BIM software must be developed within the strategic plan of the university and ensuring integration of the process with the financial plans of the university.
Infrastructure (Score: 20 / Level: initial)	
Recommendations	• Create an active and collaborative learning environment that fosters high levels of participation. • Monitor and continuously adjust the work environment to meet the needs of administrative, teaching, and student staff, recognizing that a conducive work environment is a crucial factor in motivating and engaging employees. • Establish dedicated facilities where students can receive hands-on training in BIM, equipped with the necessary software. • We recommend using standards such as the British Standard: PAS-1192 Paragraph 2, where controlling the environment with CDM.

7. Conclusion:

The current research presents a case study of a Syrian public university that teaches BIM in a specialized master's program in a systematic and organized manner under the supervision of specialized teachers. This study aims to measure the maturity of BIM at Syrian Virtual University (SVU), evaluate and develop the Building Information Modeling and Management (BIMM) master's program using the (m BIM-HEI) and electronic questionnaires, and present this master as a successful model for other

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universities to integrate BIM in their education.
After collecting and analyzing the information, SVU was found to have achieved an integrated level with a high maturity classification. It was distinguished by its inclusion of all engineering disciplines, including architecture, structure, and MEP, as well as a specialized teaching staff. Additionally, SVU has conducted numerous seminars and conferences to publish BIM and its students and teachers have published many articles on BIM. However, there is still a need to overcome technical problems and lack of support from engineering companies, as well as to develop practical courses that focus on software training. It was noted that there is a weakness in knowledge and use of BIM programs.
This master's program is expected to be a qualitative turning point in preparing for the adoption of BIM in Syria.

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